


# Lecture-18

directional and differential relays, pilot wire

# Topic Covered

- ▶ Magnitude Relays
  - ▶ Directional Relays
  - ▶ Ratio Relays
  - ▶ Differential Relays
  - ▶ Pilot Relays
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# Magnitude Relays

- Also called as Overcurrent Relay
- Response to the magnitude of input quantities ie. current.
- Energize CB trip coil when the fault current magnitude exceeds a predetermined value or trips when a current rises above a set point (pick-up current).
- If it is less than the set point value, the relay remains open, blocking the trip coil.
- Time-delay Overcurrent Relay also have the same operating method but with an intentional time-delay.

# Directional Relays

- Responds to fault only in one direction, either to the left or to the right of its location
- Operation depends upon the direction (lead or lag) of the fault current with respect to a reference voltage.
- The directional element of these relays checks the phase angle between the current and voltage of one phase, and allows the overcurrent unit to operate if this phase angle indicates current in the reverse direction.

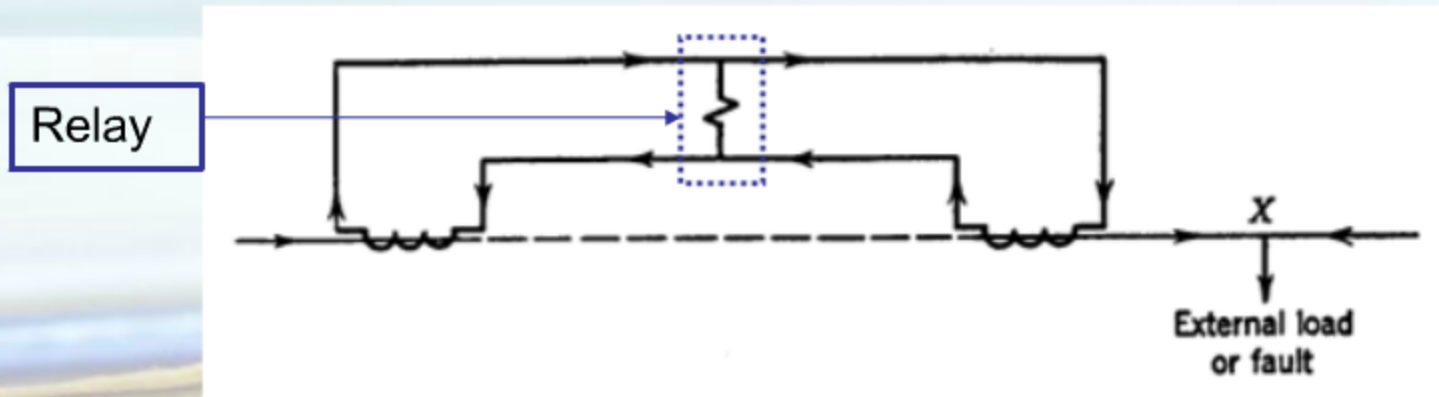
# Ratio Relays

- Operate for certain relations between the magnitudes of voltage, current and the phase angle between them.
- Measures the distance between the relay location and the point of fault, in term of impedance, reactance and admittance.
- Respond to the ratio of two phasor quantities as example Voltage and Current ( $Z = V/I$ )
- Also called impedance or distance relay

# Differential Relays

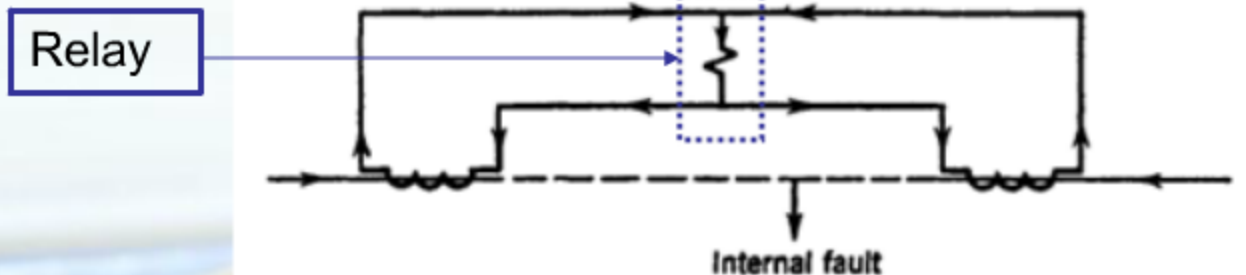
- Respond to the vector difference between two currents within the zone protection determined by the location of CTs.
- Not suitable for transmission-line protection because the terminals of a line are separated by too great a distance to interconnect the CT secondaries.
- For the protection of generators, transformers, buses,
- Most differential-relay applications are of the 'current-differential' type.

# Differential Relays



- Fault occur at X
- Suppose that current flows through the primary circuit either to a load or to a short circuit located at X.
- If the two current transformers have the same ratio, and are properly connected, their secondary currents will merely circulate between the two CTs as shown by the arrows, and no current will flow through the differential relay.

# Differential Relays



- When a short circuit develop anywhere between the two CTs.
- If current flows to the short circuit from both sides as shown, the sum of the CT secondary currents will flow through the differential relay.
- It is not necessary that short-circuit current flow to the fault from both sides to cause secondary current to flow through the differential relay.



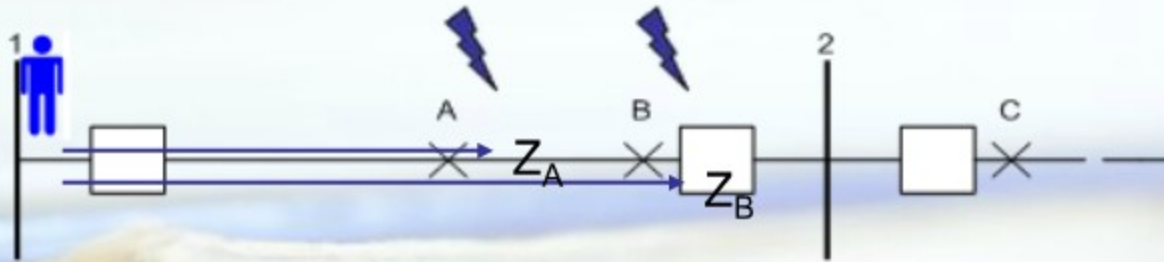
# Pilot Relays

- The term ‘pilot’ means that between the ends of the transmission line there is an interconnecting channel of some sort over which information can be conveyed.
- Use communicated information from remote sites as input signals.

# Pilot Relays

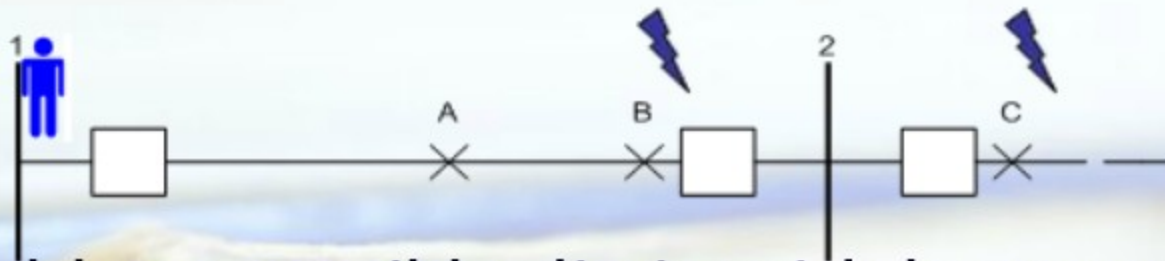
- Transmitting fault signals from a remote zone boundary to relays at the terminals of a long TL
- Pilot relaying provides primary protection only; back-up protection must be provided by supplementary relaying.
- Type : wire pilot, carrier-current pilot and microwave pilot.

# Pilot Relays



- Station 1 consist of meter for reading voltage, current and power factor.
- Distance relay, tell the different between fault at A (middle) and B (end) by knowing the impedance characteristic per unit length of the line.

# Pilot Relays



- Could not possibly distinguish between fault B and C because impedance would be so small- Mistake in tripping CB for fault B or C
- Solution- indication from station B, when the phase angle of the current at S-B (with respect to current A) is different by approximately  $180^\circ$  from its value for fault in the line section AB.